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CLAIMS

1. A substrate (1), especially a glass substrate, coated with at least one dielectric thin-film layer deposited by sputtering, especially magnetically enhanced sputtering and preferably reactive sputtering in the presence of oxygen and/or nitrogen, with exposure to at least one ion beam (3) coming from an ion source (4), characterized in that said dielectric layer exposed to the ion beam is crystallized.

2. The substrate (1) as claimed in claim 1, characterized in that said dielectric layer deposited on the substrate by sputtering with exposure to the ion beam has a very low roughness.

3. The substrate (1) as claimed in claim 2, characterized in that the dielectric layer exposed to the ion beam has a roughness at least 20 % less than that of the same dielectric layer not exposed to the ion beam.

4. The substrate (1) as claimed in any one of the preceding claims, characterized in that said dielectric layer is made of a metal oxide or silicon oxide, whether stoichiometric or nonstoichiometric, or made of a metal nitride or oxynitride or silicon nitride or oxynitride.

5. The substrate (1) as claimed in any one of the preceding claims, characterized in that said dielectric layer is made of an oxide of at least one element taken from silicon, zinc, tantalum, titanium, tin, aluminum, zirconium, niobium, indium, cerium, and tungsten.

6. The substrate (1) as claimed in claim 5, characterized in that the layer is made of zinc oxide and has a refractive index of less than or equal to 1.95, especially of 1.35 to 1.95.

7. The substrate (1) as claimed in claim 5 or 6, characterized in that the layer is made of zinc oxide and has a degree of crystallinity of greater than 90 % and especially greater than 95 %.

8. The substrate (1) as claimed in any one of claims 1 to 4, characterized in that said dielectric layer is made of silicon nitride or oxynitride.

9. The substrate (1) as claimed in any one of the preceding claims, characterized in that said layer has an argon content of around 0.2 to 0.6 at%.

10. The substrate (1) as claimed in any one of the preceding claims, characterized in that said layer has an iron content of less than or equal to 3 at%.

11. The substrate (1) as claimed in any one of the preceding claims, characterized in that it is coated with a multilayer in which a silver layer is placed on top of said dielectric layer exposed to the ion beam.

12. The substrate (1) as claimed in claim 11, characterized in that another
5 dielectric layer is placed on top of the silver layer.

13. The substrate (1) as claimed in claim 11 or 12, characterized in that the multilayer includes at least two silver layers.

14. The substrate (1) as claimed in any one of claims 11 to 13, characterized in that it has a surface resistance R_{\square} of less than $6 \Omega / \square$, or even
10 less than $2.1 \Omega / \square$, especially around $1.9 \Omega / \square$.

15. A glazing assembly and especially a double-glazing or laminated glazing assembly, comprising at least one substrate (1) as claimed in any one of the preceding claims.

16. A process for deposition on a substrate (1), in which at least one
15 dielectric thin-film layer is deposited on the substrate by sputtering, especially magnetically enhanced sputtering and preferably reactive sputtering in the presence of oxygen and/or nitrogen, in a sputtering chamber (2), with exposure to at least one ion beam (3) coming from an ion source (4), characterized in that an ion beam is created in the sputtering chamber and in that said dielectric layer
20 exposed to the ion beam undergoes a crystallization step.

17. The process as claimed in claim 16, characterized in that an oxygen ion beam is created.

18. The process as claimed in claim 16 or 17, characterized in that an ion beam is created with an energy of between 200 and 2000 eV, or even between
25 500 and 5000 eV.

19. The process as claimed in any one of claims 16 to 18, characterized in that said dielectric layer deposited on the substrate by sputtering with exposure to the ion beam has a very low roughness.

20. The process as claimed in any one of claims 16 to 19, characterized in
30 that exposure to an ion beam takes place simultaneously with the deposition of the layer by sputtering.

21. The process as claimed in any one of claims 16 to 20, characterized in that exposure to an ion beam takes place sequentially after the layer has been deposited by sputtering.

22. The process as claimed in any one of claims 16 to 21, characterized in that an ion beam is directed onto the substrate (1), especially along a direction making a nonzero angle with the surface of the substrate, preferably along a direction making an angle of 10 to 80° with the surface of the substrate.

5 23. The process as claimed in any one of claims 16 to 22, characterized in that an ion beam is directed onto at least one cathode, especially along a direction making a nonzero angle with the surface of the cathode, preferably along a direction making an angle of 10 to 80° with the surface of this cathode.

10 24. The process as claimed in one of claims 16 to 23, characterized in that the ion beam is created from a linear source.

25. The process as claimed in any one of claims 16 to 24, characterized in that at least one functional layer, especially one based on silver, is deposited on said dielectric layer and in that said functional layer undergoes a crystallization step.

15 26. The process as claimed in claim 25, characterized in that the size of the crystallites of the silver layer is increased by around 30 to 40%.

27. The process as claimed in any one of claims 16 to 26, characterized in that the dielectric layer is based on zinc oxide.

20 28. The process as claimed in any one of claims 16 to 27, characterized in that an ion beam (3) is created in the sputtering chamber (2) from a linear ion source (4) simultaneously with the deposition of the layer by sputtering and in that the deposited layer then undergoes an additional treatment with at least one other ion beam.

25 29. An installation (10) for deposition on a substrate (1), especially a glass substrate, for the manufacture of the substrate as claimed in any one of claims 1 to 14 or for the implementation of the process as claimed in any one of claims 16 to 28, which includes a sputtering chamber (2) in which at least one dielectric thin-film layer is deposited on the substrate by sputtering, especially magnetically enhanced sputtering and preferably reactive sputtering in the presence of oxygen and/or nitrogen, with exposure to at least one ion beam (3), characterized in that it includes, in the sputtering chamber (2) at least one linear ion source (4) capable of creating at least one ion beam.

30 30. The installation (10) as claimed in the preceding claim, characterized in that a linear ion source is placed so as to direct an ion beam onto the substrate,

especially along a direction making a nonzero angle, preferably an angle of 10 to 80°, with the surface of the substrate.

31. The installation (10) as claimed in claim 29 or 30, characterized in that a linear ion source is placed so as to direct an ion beam onto at least one cathode,
- 5 especially along a direction making a nonzero angle, preferably of 10 to 80°, with the surface of this cathode.